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Legacy Resource Management Program

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Conserve Gray Bat to Achieve Recovery:
Gray Bat *(Myotis grisecens)* 5-Year Status Review
Army Response to Federal Register Announcement,
March 30, 2006 (Volume 71, Number 61)

MAY 2006

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON DC 20310-0600

REPLY TO
ATTENTION OF

Environmental Programs Directorate

MAY 30 2006

Dr. Paul McKenzie
Columbia Ecological Services Field Office
101 Park DeVille Drive, Suite A
Columbia, Missouri 65203-0057

Dear Dr. McKenzie:

I am providing Army information for the five-year status review of the gray bat (*Myotis grisecens*). This responds to the Federal Register announcement on March 30, 2006 (Volume 71, Number 61).

The gray bat was listed in 1976 due to range-wide population decline. The primary cause of this decline was human disturbance of caves, and the primary recovery action identified in the 1982 Gray Bat Recovery Plan was to provide for protection of important gray bat caves. In the intervening 24 years, much progress has been made on providing permanent protection for gray bat caves. Numerous maternity caves across the range have been protected, and all of the key winter hibernacula, with the exception of Pearson's Cave, have also been protected. The Department of Defense Legacy Program has recently provided funding to the US Fish and Wildlife Service to achieve protection of this final hibernaculum.

In 2005, two issues surfaced which are important considerations in determining the actions to be taken by the US Fish and Wildlife Service in response to this five-year status review. These issues are lack of a range-wide population enumeration using consistent methodologies, and lack of a scientifically rigorous monitoring protocol for summer gray bat maternity populations.

In response to the first issue, the Army cooperated with the US Fish and Wildlife Service and several other organizations and agencies to undertake a range-wide survey of primary hibernacula during the winter of 2005-6. All accessible caves were surveyed by experienced biologists using consistent methods. This survey documented stable or increasing populations across the entire gray bat range. The only hibernaculum where a population decrease was recorded was Bat Cave, Missouri. Other surveyed caves in Missouri, and across the range, more than accounted for the decline of about 25,000 gray bats at Bat Cave. For example, estimates at Bellamy Cave, Hubbards Cave, and Bonanza Cave were up 53 percent, 232 percent and 170 percent compared to the most

recent surveys in the last several years. Based on the survey sponsored by the Army in 2005-6, we estimate the gray bat population at approximately 3 million individuals. This estimate compares favorably with a previous range-wide estimate by Harvey and Currie in 2004. Based on the hibernacula population data the Army has been able to compile range-wide, the current gray bat population substantially exceeds pre-listing levels across the range. The species does not appear to meet the criteria for either threatened or endangered.

The Army has also made significant advances in maternity cave census techniques using digital image processing. This technology has been developed in close cooperation with the US Fish and Wildlife Service, and will undergo final field testing in 2006. This technology is a significant improvement in accuracy over observer emergence counts, and the Army is prepared to assist the Service in fielding this technology across the species range.

The seven Army installations with gray bats onsite have actively managed for the species. Their management and conservation efforts have benefited the gray bat through riparian area protection/enhancement and protection of caves.

Additional detailed information collected by the Army on the gray bat is enclosed. The Army appreciates the opportunity to provide this information, and additional information if needed. We look forward to working with the US Fish and Wildlife Service in the implementation of the outcome of this five-year review.

If you have any questions regarding this information, please contact Mr. Scott Belfit, 703-601-1585, scott.belfit@hqda.army.mil.

Sincerely,

FOR , LTC, U.S. ARMY
JEFFREY G. PHILLIPS
Colonel, U.S. Army
Acting Director, Environmental Programs

Enclosure

Gray Bat (*Myotis grisecens*) 5-Year Status Review

Army Response to Federal Register Announcement, March 30, 2006 (Volume 71, Number 61)

May 19, 2006

Army Installation Information

The US Army has documented presence of gray bat at seven installations in five states: Alabama - Fort McClellan Army National Guard Training Center and Redstone Arsenal; Indiana - Indiana Army Ammunition Plant (AAP); Kentucky - Fort Campbell and Fort Knox; Missouri - Fort Leonard Wood; and Tennessee - Holston AAP. It is possible that gray bats could occur on an additional 11 Army installations (Shapiro and Hohmann 2005).

At least one professional threatened and endangered species biologist is on site at Fort McClellan, Redstone Arsenal, Fort Campbell, Fort Knox, Fort Leonard Wood, and Holston AAP. A conservation coordinator is on site at Indiana AAP.

The seven installations with documented presence of gray bat have reduced the use of pesticides. The Army is participating in a Department of Defense initiative to reduce pesticide applications on installations and reports pounds of active ingredient (PAI) applied annually since the baseline year 1993. The pounds of pesticide active ingredients applied on six gray bat installations have been cut by over 13,000 PAI per year (33,195 PAI in 1993 to 19,868 PAI in 2005). Data have not been collected for the seventh installation, Fort McClellan, since 1997, however PAI for Fort McClellan dropped from 1,365 pounds in 1993 to 370 pounds in 1997 (the last year for which data are available).

Recovery Criteria: (a) prevent disturbance to important roost habitat, (b) maintain, protect, and restore foraging habitat, and (c) monitor population trends.

Fort McClellan Army National Guard Training Center. There is no roost habitat. Foraging habitat is protected, managed, and stable or improving. Population trends are not monitored. Presence/absence monitoring is conducted approximately biennially by mist-netting, Anabat II detectors, or radio telemetry. Three such monitoring surveys were conducted in the past five years.

Redstone Arsenal. There are no known roosting sites on the installation. Foraging habitat is protected, managed, and stable or improving. Population trends are not monitored. Presence/absence monitoring is conducted by mist-netting on a periodic basis. Mist-netting was conducted in 1995 and 2005 with gray bat present both times. A bat study is scheduled to begin in 2006 which will include additional mist-netting.

Indiana AAP. There are no known roosting sites on the installation. Foraging habitat is protected, managed, and stable under two jurisdictions - Indiana AAP and Indiana Department of Natural Resources (IDNR). Population trends are not monitored. Presence/absence monitoring and use models are achieved by mist-netting and telemetry studies on a periodic basis. Mist-netting and telemetry studies were conducted in 1997, 1998, and 2004. A bat study was published by the US Fish and Wildlife Service (USFWS) (King, May 2005) which describes the mist-netting and telemetry and verifies that no roosting or roosting habitat is likely to occur on Indiana AAP. The study established that most of the gray bats roost at Sellersburg Quarry in Sellersburg, Indiana. Another similar study is planned for fiscal year 2008, and it will likely be the responsibility of the IDNR under deed restrictions that will be put in place by Indiana AAP.

Fort Campbell. There are no known roosting sites on the installation. However, nine caves have recently been discovered that will be assessed. Foraging habitat is protected, managed, stable, and being restored. Population trend is slightly increasing (one - two percent) since 1998 based on surveys of foraging bats. Monitoring is conducted by mist-netting, Anabat II detectors, and radio telemetry biennially. There have been 291 gray bat mist-net captures (including recaptures) since 1998 which constitutes 40 percent of all bat captures during that time.

Fort Knox. Conditions for gray bat have improved over the last ten years due to stream protection, more Army focus on sustainability, improved gates on two caves, emphasis on natural resources reclamation, and established buffers around streams and sinkholes. There are currently no known bachelor or maternity roosts on the installation. Two caves are protected. Grahampton Cave is an historic maternity roost, and the entrance is protected by a suitable fence. McCracken Cave has only a history of transient occupation; the entrance is protected by remoteness on the installation and a sign. Foraging habitat is protected, managed, and stable or improving. Population trends are not monitored. Fall mist-netting is conducted for Indiana bat and serves to monitor presence/absence of gray bat. Mist-netting indicates consistent distribution in the Otter Creek watershed.

Fort Leonard Wood. Habitat on the installation has become more favorable for the gray bat during the last twelve years, a time when most bat conservation efforts have been conducted on the installation. This improvement is due in part to improved protection of caves, protective measures around riparian areas, reduction in pesticide usage, and an endangered species awareness program and literature. There are currently two confirmed roost sites on the installation. Salt Peter No. 3 cave is a known maternity roost and Freeman cave is a transient cave. The entire suitable roost habitat is protected from disturbance. Foraging habitat is protected, managed, and stable or improving. The Missouri Department of Conservation conducts periodic summer surveys of the caves, and Fort Leonard Wood contracts a general count within the caves twice seasonally, but not during the prime maternity period. From these monitoring efforts, all indications are that the population is fluctuating but stable on the

installation. When mist-netting was conducted, gray bat captures were only second to red bats, indicating a large population of gray bats foraging on the installation.

Holston AAP. There are no known roosting sites on the installation. Foraging habitat is protected, managed, and stable. Population trends are not monitored. Presence/absence monitoring is planned using Anabat II detectors. Some mist-netting has been done in the past and is planned in the future.

Biology and Habitat: (a) Habitat or ecosystem conditions, (b) spatial distribution, trends in spatial distribution, and (c) abundance and population trends.

Fort McClellan Army National Guard Training Center. This installation is approximately 22,300 acres. Foraging habitat includes nine miles of stream with two 1-mile tributaries and about 500 acres of open wetlands. There are three - four roost caves within foraging distance of the installation; one of the caves is Weaver Cave. Distribution of foraging bats has been stable over the past five years, primarily using the stream corridor.

Redstone Arsenal. The installation is 40,000 acres bordering the Tennessee River. About 25 percent of Redstone Arsenal is foraging habitat. There are 10,000 acres of wetlands. Roost caves exist within 5-10 miles on two sides of the installation. Gray bat distribution for foraging on the installation is stable and consistent.

Indiana AAP. The installation is 9,790 acres. Foraging habitat includes small streams and riparian areas. Two primary foraging areas are Jenny Lind Creek (two miles) and Little Battle Creek (one and one fourth miles). Gray bat distribution for foraging on the installation is stable and consistent.

Fort Campbell. Fort Campbell is 105,000 acres. It contains 422 miles of streams in nine sub-watersheds and two lakes (81 and 18 acres). Ninety percent of the installation is foraging habitat. A geophysical survey in 2005 found nine caves. The installation is in the process of assessing the roosting value/status of these caves.

Fort Knox. Fort Knox is 109,000 acres. It contains 55 miles of streams, 22 ponds and lakes, and 2,359 acres of wetlands. Two known bat caves occur on Fort Knox. Grahampton Cave and McCraken Cave are located in the Otter Creek watershed adjacent to Carlson Lake along the western boundary of the installation. Gray bats have been reported to roost in both caves during the spring, summer, and fall months, with the greatest numbers present in March and September (Carter and Merritt 1995). Gray bats have not been observed in these caves during winter surveys (White et al. 1994). Survey data suggest that the Fort Knox caves are used as transitional roosts during migration between summer and winter habitats, and during foraging trips from primary summer caves (BHE Environmental, Inc. 2001). Although there is evidence that a gray bat colony with as many as 10,000 bats may have occupied Grahampton Cave in the past (Bryan and MacGregor 1982, White et al. 1994), recent surveys have estimated fewer than 150 individuals (137 in Grahampton Cave in September 2000; 91

and 50+ reported respectively from McCraken Springs Cave in 1994 and 2000). Eight additional caves exist on Fort Knox, but gray bats have not been documented for any other caves surveyed (BHE Environmental, Inc. 2001).

Carter and Merritt (1995) suggested that gray bats roosting in Grahampton and McCraken Caves likely forage along major Fort Knox watercourses (Otter Creek, Rolling Fork, Salt River, Mill Creek) and their tributaries. During mist-net surveys conducted in 1992 and 1993 by White et al. (1994), seven male gray bats were captured along Otter Creek. During 2002-2003 mist-net surveys, four male gray bats were captured at sites along Cedar Creek in the extreme southern part of the installation and at Upper and Lower Otter Creek in the west-central region (C. O. Martin, unpublished data). Gray bats were recorded at numerous sites in watersheds throughout the installation using Anabat II detectors during 2002-2004 surveys (R. A. Lance, unpublished data). They were particularly active over Upper and Lower Douglas Lake in the southern part of the installation. Although gray bat numbers appear to have dwindled in Fort Knox caves, they were recorded frequently during recent summer Anabat II surveys. It is apparent that gray bats use a variety of riparian and aquatic resources available on Fort Knox (Martin et al. 2006).

Fort Leonard Wood. Fort Leonard Wood is 61,410 acres. It contains 10 streams with 34 miles of permanent flow. There are two categories of stream on the installation. The Big Piney and Roubideux are classified as Type 1-major streams. They are 10 miles and 13 miles long, respectively. Eight other streams are categorized as Type 2 – smaller creeks, and are 11 miles in length. Total acreage of riparian habitat on the installation is estimated at 3,000 acres, all of which are considered gray bat foraging habitat. The installation is located predominantly in Pulaski Co., is near the center of gray bat range in Missouri, and is also near the center of counties occupied by the "central subpopulation" in the state (3D/Environmental 1996). Most bats in the central subpopulation hibernate in Coffin Cave in Laclede Co. This subpopulation is the largest in Missouri in respect to the number of bats, number of maternity caves, and geographic area occupied. In 1992, gray bats within the central subpopulation were characterized as stable to increasing (Missouri Department of Conservation 1992).

Several caves located on Fort Leonard Wood and in the vicinity are known to provide roosting habitat for gray bats. A gray bat maternity colony occurs in Saltpeter No. 3 Cave. The State conducted an exit count of the Salt Peter No. 3 cave in 2002 or 2003 and estimated 3,000 to 5,000 gray bats. Freeman Cave is used as a roost site by transient gray bats during migration. Evidence suggests that Freeman cave may have been a maternity roost in the past. There are also four Indiana bat caves where small numbers of gray bats (15-20) have been occasionally found wintering with Indiana bats. Great Spirit Cave, located 2.2 miles west of Fort Leonard Wood, also supports a maternity colony (Missouri Department of Conservation 1992, 1994, Glueck personal communication 2006). There are also a number of caves within a mile of the installation that contain bachelor groups. These bats are all believed to forage on the installation. Gray bats have been found foraging throughout favorable habitat on the installation.

Holston AAP. Holston AAP is 6,025 acres. Foraging habitat includes 4.5 miles of the Holston River and one mile of Arnott Branch, approximately 90 acres. Two caves exist on the installation. They were surveyed in 2002 and found not to be serving as roost habitat. A borrow pit may have potential as a maternity roost since one juvenile bat was found last year, and no maternity roosts are known within 10 miles of Holston AAP. The borrow pit will be assessed for roost potential in 2006 or 2007.

Threats, conservation measures, and regulatory mechanisms

Fort McClellan Army National Guard Training Center. There are no threats to gray bat. The installation has a current (less than five years old) Endangered Species Management Component of the Integrated Natural Resources Management Plan (INRMP) that provides for management of gray bat. The plan is approved by the USFWS and State. Management consists of protection of wetland and riparian areas and restriction of pesticide applications. The stream and corridor have been designated a Special Interest Natural Area. No activities are permitted within 50 meters of the creek, and no pesticide applications are permitted within 300 meters.

Redstone Arsenal. There are no threats to gray bat. The installation has a current (2006) Endangered Species Management Component of the INRMP that provides for management of gray bat. The plan is approved by the USFWS and State. Management consists of protection of wetland and riparian areas and restriction of pesticide applications.

Indiana AAP. There are no threats to gray bat. Indiana AAP has been declared excess to Army and is being disposed. Ammunition plant missions have ceased. About half the installation is or will be in control of the IDNR by lease or ownership. The half that will be in State control contains the entire foraging habitat. IDNR will use the land for outdoor recreation, but the Army assures deed and lease restrictions are in place requiring the State to protect gray bat habitat. The other half of the property does not contain bat habitat. It will go to the River Ridge Development Authority with deed restrictions requiring protection of sink holes and karst features to maintain water quality. The property being acquired by the State is also being fenced to control access.

Indiana AAP has an INRMP dated 1997 and an Endangered Species Management Plan dated April, 2000 that provide for management of gray bat. Both plans are approved by the USFWS and State. Deed restrictions require INDR to maintain a conservation plan for gray bat. Current management consists of access restrictions to foraging areas; protection of stream, riparian, and karst areas; and restriction of pesticide applications in foraging areas. Tree planting was recently accomplished along a stretch of Jenny Lind Creek as part of an industrial site clean up project. Gray bat management at Indiana AAP is a collective effort among the Army, INDR, and USFWS.

Fort Campbell. There are no threats to gray bat. The installation has a current Endangered Species Management Component of the INRMP that provides for

management of gray bat. The plan was updated in 2004 and is approved by the USFWS and State. Conservation actions include protection and restoration of foraging habitat. Monitoring helps prioritize the locations to focus conservation actions. Based on integrated land use priorities, the installation is developing Total Maximum Daily Load criteria for streams to improve water/foraging quality. Priority watersheds are evaluated by impairments, and improvements are developed and implemented to improve water quality and increase the in-stream insect yield. Intermittent and permanent streams are protected by 50 and 100 foot buffers, respectively. Pesticide use in the stream corridors is restricted as are all other activities. Basically, no activities occur in the stream corridors without coordination with the installation threatened and endangered species biologists. The installation participates in the Tennessee Bat Working Group which facilitates sharing of information and integration of regional management.

Fort Knox. Threats at Fort Knox have been eliminated. One biological opinion exists, but does not contain conservation measures. The installation has a current (less than five years old) INRMP that provides management of gray bat. The plan is approved by the USFWS and State. The installation protects a 70 foot buffer around all water resources, including sinkholes. A current Integrated Pest Management Plan implements integrated pest management and is coordinated with the INRMP. Special care is taken to reduce pesticides used in or near water resources. Two low water crossings for military vehicles have been constructed on Otter Creek to protect water quality and prevent the need for military vehicles to enter the creek. Best Management Practices are used in soil disturbing activities and Soil Erosion Control Plans are used when required by the Clean Water Act. Under the Base Realignment and Closure Act, the mission at Fort Knox will change. The new mission is expected to have less impact on natural resources than the current mission.

Fort Leonard Wood. Threats have been significantly reduced. Gray bat management guidelines specific to Fort Leonard Wood are included in the installation Endangered Species Management Plan (ESMP). Although the ESMP has not been signed off by the USFWS, they have concurred with the management and conservation strategies for the gray bat. Revisions of both the ESMP and INRMP are near completion and are projected to be sent to the State and USFWS for review in early summer 2006. Management and protection related to gray bats at Fort Leonard Wood are accomplished, in part, through protection zones and use restrictions related to the operational activities conducted at the installation. Signs restricting human access during the roosting season (April 1 to October 31) are posted at the entrance to Saltpeter No. 3 Cave and Freeman cave. Infra-red monitors are also set up in a number of caves to detect disturbance. These devices are checked twice seasonally and disturbances are recorded. Entrances of caves are also raked for detecting unauthorized activity. Monitoring of the caves, greater security to reduce unauthorized entry onto the installation, and location of the gray bat roosting sites have all greatly reduced unauthorized entry into the caves. Additional habitat management and restrictions for gray bats around caves are as follows: (1) Maintain a contiguous forest canopy by uneven age timber management or protection in the immediate 20 acres

above and around the opening of the cave, (2) maintain restrictions on activities within an additional 140 acres of the cave to ensure integrity of travel corridors for access to riparian foraging areas, (3) maintain general controls within one km of cave for additional protection, such as contacting natural resources team prior to any tree removal.

In order to maintain water quality of streams, the installation has implemented the following measures: (1) no filling or digging around riparian areas without a permit, (2) control of bivouacking on a case-by-case basis, (3) control of stream crossings only at fording sites (small streams have low water crossings), (4) no off road use of vehicles, and (5) no pesticide usage within riparian areas. Additional gray bat conservation measures implemented by the installation are restricting the use of fog oil smoke for training during the active nightly foraging period, planting 14 acres within Roubideux Creek to improve foraging habitat, implementing water quality management efforts through monitoring sedimentation and storm water control, and eliminating timber harvesting within riparian zones. The natural resources team also monitors use of riparian areas.

The installation has an agreement with the Missouri Department of Conservation for monitoring. No other partnerships currently exist. However, there is a lot of public land adjacent to the installation where gray bat conservation strategies are also being implemented.

Planned activities on the installation may require greater storm water control efforts. Due to the re-stationing program, the 94th heavy combat engineer battalion will be stationed on the installation. The battalion will be conducting activities in upland sites, but within the Big Piney watershed. Increased sedimentation and storm water issues will be addressed.

Holston AAP. There are no threats to gray bat. Base Realignment and Closure plans include establishing a new US Army Reserve/National Guard training capability at Holston AAP. The action will not result in a threat to gray bat. The installation has an INRMP that was approved by the USFWS and State in 2000. The INRMP is being updated, and an Endangered Species Management Component addressing gray bat is 85 percent complete. The gray bat component will be completed this year. Ongoing management includes protection of riparian areas, planting trees along the river and stream, and use of Tennessee Best Management Practices in stream/river corridors. Both caves are protected from human activity, even though they are not currently being used for roosting. The installation recently completed 1,500 feet of new stream by diverting production facility cooling water. This created new foraging habitat and maintained the original stream insect production capability.

Range-wide Information

Roost Habitat.

Much progress has been made on providing permanent protection for gray bat caves. Numerous maternity caves across the range have been protected, and all of the key winter hibernacula, with the exception of Pearson's Cave, have also been protected. The Department of Defense Legacy Program has recently provided funding to the US Fish and Wildlife Service to achieve protection of this final hibernaculm.

Gray Bat Counting and Trend Analysis.

A series of papers regarding monitoring trends in bat populations was recently published as a US Geological Survey Information and Technology Report (O'Shea and Bogan 2003). The report resulted from a workshop that included participation from leading experts in sampling and analysis of wildlife populations and bat biology and conservation. Information from the report relevant to the status of gray bat populations is summarized in the following paragraphs.

Tuttle (2003) stated that population monitoring was relatively straight-forward for gray bats because they typically concentrate in relatively conspicuous groups of tens of thousand individuals that live year-round in caves along waterways. Although estimating their exact numbers remains difficult, they aggregate in predictable fashion at specific summer nursery roosts, where they stain ceilings and leave large guano deposits that allow relatively consistent population estimates. However, Tuttle (2003) explained that many bats that hibernate in known caves may also use other locations unknown to humans. Also, counts may be difficult because bats form clusters of varied density, often high above the cave floor, which forces observers to estimate numbers based on knowledge of normal clustering behaviors and densities for each species. Tuttle (2003) emphasized that the most reliable means of determining roosting density is to construct a sturdy frame that encloses a specific area within which all bats can be counted (Tuttle 1975, Thomas and LaVal 1988). He further stated that while conducting winter surveys, all assumptions made regarding clustering densities and areas covered by bats should be recorded for each roosting area. Additionally, where assumptions or estimates are made without actual measurements, they should be made and recorded independently by at least two individuals (Tuttle 2003).

Kunz (2003) noted the following methods historically used for censusing bats: roost counts, evening emergence counts, evening dispersal counts, and disturbance counts. A combination of traditional census methods and recently developed remote censusing techniques was suggested to offer the greatest promise for estimating population sizes of most species. Thermal infrared (TIR) imaging was discussed as a promising technique for censusing bats as they emerge from roosts. An advantage stated for TIR imaging was that individuals can be censused independent of the ambient light at the time of emergence. However, successful application of the method requires a uniform

background behind the bats so that this background can be digitally subtracted from the images of emerging bats (Kunz 2003). The TIR imaging process for bat surveys is described in Sabol and Hudson (1995) and Melton et al. (2005). Kunz (2003) stated that censusing hibernating bats is best achieved by counting each individual bat or group of bats as they are encountered, or by estimating the mean density of bats in several representative clusters, and extrapolating this density to the total are of the cave wall or ceiling that is covered by bats. Surveys of hibernating bats should be limited to one census period every other year (Kunz 2003).

Ellison et al. (2003) compiled 1,879 observations of gray bats gathered from 334 roost locations throughout the species range. The majority of observations were collected from Missouri (735), Arkansas (377), Alabama (273), and Kentucky (194). Counts included maternity colonies (866), transient roosts (301), hibernacula (196), and bachelor colonies (101). Thirty percent of the observations were made after 1990. Information was analyzed from counts at 103 summer colonies and 12 hibernacula in Alabama, Arkansas, Florida, Illinois, Kansas, Kentucky, Missouri, and Tennessee. The majority of the data from summer colonies showed no trend; nine indicated an upward trend, and six indicated a downward trend. Also, no trends were detected for seven of the 12 hibernating colonies; three showed an upward trend and two a downward trend. Few data were said to be available for gray bat hibernation sites because of their sensitivity to disturbance. Even though this compilation of data from various sites did not show an obvious trend in gray bat populations, Ellison et al. (2003) stated that recovery efforts by the USFWS and others have suggested that gray bat numbers have rebounded in recent years. At the time the Recovery Plan was written, the gray bat population was thought to be approximately 1,575,000 across its range. In 2002, the total population was estimated to be 2,678,137, an increase of 61.5 percent from the time the plan was written (Ellison et al. 2003).

Southeastern Bat Diversity Network Assessment

The Southeastern Bat Diversity Network (SBDN) is regional bat working group that meets annually in conjunction with the "Colloquium on Small Mammals in the Southeastern United States." SBDN is composed of biologists from various agencies, organizations and academia who specialize in bat biology, ecology, and management. In 2000, the Steering Committee of the SBDN met in Miami, FL, and requested that Dr. Michael J. Harvey (Tennessee Tech University) gather current gray bat population data to reassess the status of the species. Dr. Harvey had reported that the gray bat seemed to be doing well because numerous important caves had been protected and the species appeared to be one of the most abundant bats within its range. Thus, it was felt that a change in status was appropriate and would add credibility to the endangered species recovery effort (Michael J. Harvey, personal communication).

In 2001, at the SBDN Annual Meeting in Memphis, TN, Dr. Harvey and Robert R. Currie (USFWS, Asheville, NC) summarized the recovery progress for the gray bat and the conservation implications of changing the status of the species from Endangered to Threatened. Based upon this information, SBDN members passed a resolution

supporting this action and directed the SBDN board to send a letter to the USFWS recommending that the gray bat be down-listed to Threatened. The Board complied with this resolution (Harvey and Currie 2004). In 2003, the USFWS Columbia Field Office sent out a formal request to all states and bat researchers within the range of the gray bat for updated information on the historic and current status of the species. The Nature Conservancy, Tennessee Department of Conservation, Tennessee Valley Authority, and others reviewed their records and provided the most recent information on the gray bat in Tennessee. This was compiled and provided to the Columbia Field Office during the summer of 2003. The USFWS also received updates from other states within the species range (Harvey and Currie 2004).

Harvey and Currie (2004) further reported that the Columbia Field Office reviewed the gray bat data and planned to submit a proposal for down-listing the species to the Regional Office. The proposal would recommend a plan to down-list the gray bat from Endangered to Threatened by the end of FY 2005. However, a review of the 2003 data revealed concerns with lack of standardization of methods for surveying gray bat populations. Methods used included exit counts at cave entrances, fresh guano measurements, direct observations of adults and young, direct observations of young only, or some combinations of these methods. Since methods have not been standardized, direct comparisons of the numbers generated was difficult. Nevertheless, it appeared that the total range-wide population of the gray bat may be as high as 3,000,000 (this compares to the less formal summary presented by the authors at the 2002 SBDN meeting that reported a range-wide population estimate of about 2.7 million). The significant message from this presentation is that the gray bat is doing well and that a reexamination of its status was appropriate (Harvey and Currie 2004).

2005-2006 Hibernacula Surveys

A multi-agency working group was convened in 2005 to examine the current status of the gray bat and determine actions that were needed in order to consider reclassification of the species. Protection of critical hibernacula was considered one of the most critical steps to reclassify the species. A major obstacle preventing a determination that the gray bat is recovered was the absence of data from a recent range-wide survey of wintering populations at major hibernacula. Agency personnel examined information from known hibernacula and prioritized caves that were considered critical for long-term protection of the species. The following 12 caves were identified as priority caves for inclusion in 2005/2006 hibernacula surveys based on input from the USFWS, Bat Conservation International, and state agency personnel. The survey represents a coordinated effort among the USFWS, US Army Research and Development Center, US Forest Service, Tennessee Valley Authority, Bat Conservation International, The Nature Conservancy and the states of Missouri, Arkansas, Tennessee, Alabama, and Kentucky. Robert Currie, USFWS Asheville Field Office, scheduled and coordinated the cave surveys and reported results to US Army Engineer and Research Center.

- Bellamy Cave, TN
- Hubbards Cave, TN
- Pearsons Cave, TN
- Blanchard Cave, AR
- Bonanza Cave, AR
- Cave Mountain Cave, AR
- Coffin Cave, MO
- Mose Prater Cave, MO
- Bat Cave (Shannon Co.), MO
- Coach Cave, KY
- Jesse James Cave, KY
- Fern Cave, AL

Gray bat surveys were conducted in major hibernacula caves in Tennessee, Missouri, and Arkansas during the 2005-2006 wintering period. Results of these surveys are presented below. The current status of Kentucky and Alabama caves is also discussed.

Tennessee

Surveys were conducted in Bellamy Cave and Hubbards Cave, TN on 10-11 January 2006. Population counts were made by Dr. Merlin Tuttle, Mr. Jim Kennedy, and Ms. Kari Gaukler, Bat Conservation International (BCI), and Ms. Heather Garland, The Nature Conservancy (TNC). Personnel with the Tennessee Wildlife Resources Agency also attended the survey of Hubbards Cave. We also had planned to visit Tunnell (Pearsons) Cave during this period but were denied access by the property owner.

Bellamy Cave – The survey of Bellamy Cave documented 139,364 hibernating gray bats. Independent counts by Tuttle and Garland ranged from 137,525 (Garland) to 141,203 (Tuttle), a difference of 2.6 percent. These numbers were averaged to obtain the final estimate of 139,624. This represented a 53 percent increase from the last census in 2003 when 91,100 bats were counted, suggesting an average annual increase of 13.25 percent. Approximately 200 Indiana bats also were observed in Bellamy Cave, which were the first documented for this cave in many years (Tuttle and Kennedy 2006).

Hubbards Cave – The survey of Hubbards Cave resulted in an estimate of 520,326 gray bats (average of independent counts). Independent counts were 550,430 (Garland) and 490,222 (Tuttle). The estimate is a 232 percent increase from the last census in 2002, indicating an average annual increase of 58 percent. Hubbards Cave has historically been heavily disturbed and vandalized, and by the mid-1960s only a few thousand gray bats could be found. In 1968, approximately 250,000 gray bats were discovered in low sections of the cave.

Arkansas

Surveys of Blanchard Springs Cave, Bonanza Cave, and Cave Mountain Cave were conducted by Dr. Michael J. Harvey and Mr. Blake Sasse on 21 January 2006. The total combined count for these caves was 416,495 gray bats.

Blanchard Springs Cave – The January 2006 Blanchard Springs Cave count was 128,005 gray bats. The 1985-86 winter counts at Blanchard Springs Cave had dropped to a low of 33 gray bats, from a previous high of 5,000 to 6,000 bats. Since that winter, the USFWS has limited disturbance to the roost site.

Bonanza Cave – The 2006 count for Bonanza Cave was 148,750 gray bats. During the winter of 1998-99 a large portion of the bluff above Bonanza Cave collapsed, partially blocking the entrance and destroying the gate. The 2001-02 winter count at Bonanza Cave was 55,000 gray bats; the previous high was 250,000. The cave was re-gated by the US Forest Service during the summer of 2002.

Cave Mountain Cave – The January 2006 Cave Mountain gray bat count was 139,740. Historically, the 1981-82 winter count at Cave Mountain Cave was 50 gray bats, and no more than 700 gray bats had ever been reported from the cave. The cave was fenced by the National Park Service during the summer of 1982.

Missouri

Mid-winter surveys were conducted at three Missouri caves (Coffin Cave, Mose Prater Cave, and Bat Cave) in 2005-2006. The surveys were conducted by Rick Clawson, Resource Scientist, Missouri Department of Conservation, and Bob Currie (USFWS). Assistance was provided by Bill Elliot, Jim Kaufman, Rita Worden, and Peggy Horner (Missouri Department of Conservation) and Scott House and George Bilbrey (Cave Research Foundation). The total combined count of gray bats for these caves was 743,600.

Coffin Cave – Coffin Cave, Laclade Co., was surveyed on 24 Jan. 2006. The survey resulted in an estimate of 561,000 gray bats. This was compared to 355,450 estimated during the last count in 1985/1985. Approximately 250,000 gray bats were reported during a 1978/1979 survey. Other previous counts were 316,300 in 1980/1981 and 349,500 in 1982/1983 Rick Clawson, unpublished data).

Mose Prater Cave – An estimate of 155,000 resulted from the survey of Mose Prater Cave, Shannon Co. on 25 Jan 2006. This compared to 93,000 during the last count in 2002/2003. The lowest count was 53,900 in 1975/1976. Other counts ranged from 89,500 in 1980/1981 to 112,200 in 1982/1983 (Rick Clawson, unpublished data).

Bat Cave – A count of 27,600 gray bats was estimated for Bat Cave, Shannon Co. on 25 Jan 2006. This represented a decrease from 57,850 in 2004/2005. Since

1974/1975, winter counts have ranged from approximately 11,500 to 46,000, with considerable variation from year to year (Rick Clawson, unpublished data).

Kentucky

Coach Cave and Jesse James Cave were surveyed in 2003, and populations in both caves appear to have remained stable (Traci Hemberger, Kentucky Department of Fish and Wildlife Resources, personal communication). Coach Cave was also surveyed in 2005, but it was impossible to get a count in Jesse James because of damage to steps that had fallen through. The 2005 estimate for Coach Cave was over 260,000 bats. The last count in 2003 was approximately 200,000, but an estimate of 300,000 was reported in 1996-97. Recent counts represent a significant increase over historical counts of 100,000 to 15,000 bats in the late 1960s and early 1970s. Both Coach and Jesse James Caves are gated but there is no long-term assurance of their protection. The caves are privately owned by the same person, who resides in Mexico. The state has been and is trying to secure the caves.

Alabama

Fern Cave, the only Alabama cave, is considered too treacherous for making a winter count. An estimate of approximately 700,000 gray bats has been documented for Fern Cave during recent counts.

Discussion

When the Recovery Plan was written, gray bat population was thought to be approximately 1,575,000 across its range. In 2002, the total population was estimated to be 2,678,137, an increase of 61.5 percent from the time the plan was written (Ellison et al. 2003). Now (2006) the population is estimated at 3,000,000.

Population data for the gray bat were obtained through various sources, including the published literature, state and contract reports, and the personal communication with bat researchers and resource managers. Historical population estimates were reviewed for maternal colonies and hibernacula. Recent surveys revealed that gray bat populations had increased substantially throughout the species range, and this resulted in a recommendation for reviewing the status of the species (submitted to the USFWS by the SBDN in 2001).

In Bellamy Cave, TN, the gray bat has recovered from only 65 individuals at the time of listing in the 1970s to its current population of over 139,000, estimated during 2005-06 hibernacula surveys (Tuttle and Kennedy 2006). The population estimate for the previous winter count in 2002 was 91,000. The cave and 30 acres of surface property were purchased by The Nature Conservancy in 2005; these properties are scheduled to be turned over to the Tennessee Wildlife Resources Agency in 2006. The population in Bellamy Cave appears stable, but Tuttle and Kennedy (2006) suggested that it was unlikely that the population would indefinitely continue its rapid growth because of

higher than desirable hibernation roost temperatures. During the 2005-06 survey, a small sink hole entrance adjacent to the protected property was noted. Tuttle and Kennedy (2006) stated that this adjacent area should be monitored because changes to the entrance could affect air flow and temperatures in the main portion of the cave.

The Hubbards Cave 2005-06 population estimate was 520,326, compared with 156,726 during the 2002 survey. Hubbards Cave has been historically heavily visited and vandalized. By the mid-1960s only a few thousand gray bats could be located in areas accessible to humans. Raccoons had also preyed heavily on bats that were forced to roost at lower elevations than desirable. Human disturbance has been eliminated in the cave and bats are now able to utilize colder, more elevated sites near the entrance. Tuttle and Kennedy (2006) stated that there is real potential for this population to exceed a million within the next 10 years or less. The Nature Conservancy has provided long-term protection for Hubbards Cave; one of the three protective gates at the cave has deteriorated and will be replaced in 2006.

An estimated 180,000+ gray bats are known to inhabit approximately 20 Arkansas maternity and bachelor caves during the summer, while approximately 350,000+ hibernate in five Arkansas caves during the winter (Harvey et al. 2005). The difference between estimated Arkansas summer and winter populations occurs because many gray bats that hibernate in Arkansas are known to migrate to summer caves in nearby states. Also, some gray bats that hibernate in Missouri caves are known to summer in Arkansas caves. Harvey et al. (2005) noted considerable variation in the Bonanza Cave hibernating population, and stated that estimates were difficult because of the cave configuration and collapse of a portion of the bluff above the cave entrance during the winter of 1998-99. The usual estimate in Bonanza Cave until recent winter was 250,000, but the population decreased to 55,000 during February 2002. However, an estimated 107,710 gray bats were observed hibernating in the cave in 2003-04 (Harvey et al. 2005). The 2005-06 winter survey resulted in an estimate of 148,750, suggesting a stable to increasing population at the site.

Army Research and Studies

Fort Leonard Wood. Several gray bat field studies were conducted during 1994 and 1995 to provide data on gray bat populations and potential impacts of military operations on Fort Leonard Wood. A radio telemetry study was conducted to determine gray bat habitat use, foraging zones, and behavior with and without active training exercises. Mist-net surveys were conducted to determine the distribution of gray bats on the installation during the summer of 1994. Noise and seismic studies were performed in an attempt to determine the response of gray bats in Saltpeter No. 3 Cave to military-generated airborne and substrate-borne sound. Insect sampling provided a baseline description of available gray bat prey species, and fecal sampling characterized local gray bat prey. These studies are described in detail in 3D/Environmental 1996.

Fort Knox. Fort Knox was the setting for a study conducted during 2002-2004 to investigate the potential impacts of military training noise, primarily high-caliber weapons fire, on the behavior of bats. Standard mist-netting procedures and ultrasonic sound detection using Anabat II detectors were used to determine the presence of bats in selected areas. Anabat II and thermal infrared (TIR) cameras were used simultaneously to monitor bats subjected to high-caliber weapons fire, rocket fire, machine gun fire, and helicopter noise (Martin et al. 2004). Statistical analysis of bat vocalizations, TIR imagery, and military noise data showed extremely large variations in bat response variables across space and time. There were no consistent, significant differences in measures of bat activity associated with military noise at a fixed site (i.e., firing and non-firing times at the same site), firing and non-firing sites, or types of military noise. Thus, results indicated that elevated noise level associated with high-caliber weapons fire, as tested, did not have a significant effect on bat navigation and foraging activity at the established Fort Knox firing ranges (Martin 2005). Although limited data were collected specifically on gray bats as part of this study, there was no evidence to suggest that this species responded differently than other bats monitored.

US Army Engineer and Research Center: Development of Gray Bat Censusing Techniques Using Digital Image Processing

Video imaging using night vision imagers has been a preferred methodology for accurately censusing colonial bats during emergence from caves. However, analysis of the data is very time intensive. The Army is undertaking research to improve data analysis of night vision imagers by applying an automated detection and tracking program to several different types of video imagery.

The primary objectives of this research are:

- Complete development of a digital image processing software system capable of detecting, tracking, and enumerating bats flying from and to a roost site;

- Test and modify the software to accommodate use of low-cost illuminated near infrared or light intensified cameras in addition to thermal infrared imagers;
- Conduct surveys in cooperation with the USFWS to compare the new image analysis technique with established census techniques at priority gray bat roost sites; and
- Generate software and user guidance documentation for use of the methodology, and prepare manuscripts for peer-reviewed journals describing the results of the research.

In 2005, researchers from the Army accompanied USFWS personnel in conducting test and evaluation activities of this technology at gray bat caves in Alabama, Tennessee, Kentucky, Missouri, and Arkansas. At each site, this team was joined by local resource agency personnel who routinely monitor the caves. The data collected during this field trip permitted a comparison among a variety of techniques for censusing gray bats. Results from this data collection effort found that digital image processing software emergence counts reflected no statistical difference from human analysis of thermal imagery; however, there was significant difference between emergence counts made by trained observers and emergence counts using digitally-processed imagery.

The documentation of the software for analysis of thermal imagery is now complete, and the documentation of the software for analysis of near infrared imagery is in the final stages of development. The technology was briefed to 150 persons at the Southeastern Bat Diversity Network in winter 2006, and a number of field biologists are prepared to deploy this tool when it is completed. A final field validation season is proposed in 2006.

US Army Engineer and Research Center: Assessment of Intercolony Genetic Structuring in the Gray Bat

The Army is exploring the use of DNA markers to identify summer-winter roost relationships in gray bats. Knowing the identity of winter hibernation roosts used by gray bats that summer in caves on Army installations is an important element in the development of comprehensive management plans for this species.

There are three primary tasks being addressed in this research to determine potential utility of DNA markers:

- Identify adequate genetic markers for tests of genetic differentiation among hibernacula populations,
- Determine the extent of genetic differentiation among hibernacula populations, and
- Estimate the predictive power of selected genetic markers to "assign" individual gray bats from summer populations to different hibernacula populations.

DNA samples (bat pellets) have been collected from across the species range in Arkansas, Kentucky, and Missouri. Forty one different microsatellite loci have been

under evaluation, and eight microsatellite loci have been identified as promising, with 11 eliminated from further consideration. Work has begun on obtaining microsatellite genotypes from scat samples. The initial run had mixed results and other analysis techniques will be used. Researchers may also consider utilization of mitrochondrial DNA markers if necessary. If research identifies genetic differentiation from hibernacula across the range, then this technique will be applied in an attempt to identify hibernacula used by summer maternity colonies found at Fort Leonard Wood caves.

Department of Defense Legacy Resource Management Program - Project: Conserve Gray Bat to Achieve Recovery

It was the general consensus of gray bat experts gathered in August 2005 that the population of gray bats has recovered across the range of the species. The two main obstacles preventing consensus that the species is recovered are the lack of a recent, range-wide survey of major populations, and the lack of an accepted inventory and monitoring protocol (to meet the requirement that the species be monitored for five years following de-listing). In addition, the assembled experts felt that certain other conservation actions were necessary to fully meet recovery plan goals.

The Department of Defense Legacy Resource Management Program project, called "Conserve Gray Bat to Achieve Recovery", was developed and approved in 2005 and 2006. The project has contributed $99,100 to the USFWS for action and completion. In addition, the partners are contributing actions valued at more that an estimated $70,500. Primary partners include Bat Conservation International, The Nature Conservancy, Tennessee Tech University, Tennessee Valley Authority, Tennessee Wildlife Resource Agency, Missouri Department of Conservation, Arkansas Game and Fish Commission, Kentucky Department of Fish and Wildlife Conservation, USFWS, US Forest Service, and US Army.

The following tasks are included in the project:

- Provide an improved gate for Bellamy Cave, TN
- Secure protection of Pearsons Cave, TN
- Repair access steps to Jesse James Cave, KY
- Survey 5-10 maternity caves in TN
- Hibernacula surveys of nine caves in MO,TN, and AR

Additionally, the Legacy program requires a Fact Sheet for each project. A Technical Report will also be provided.

The hibernacula surveys have been completed using partner funds provided by the US Army Engineer Research and Developement Center. A gray bat planning meeting was held on March 21, 2006 during the North American Wildlife and Natural Resources Conference in Columbus, Ohio. The purpose of the meeting was to clarify components of the Legacy project and assign responsibility for action items.

Status of Project

Hibernacula surveys have been completed. A total of 1,819,785 bats were estimated for the eight caves surveyed (Bellamy and Hubbards Caves, TN; Blanchard Springs, Bonanza, and Cave Mountain Caves, AR; and Coffin, Mose Prater, and Bat Caves, MO). An additional 260,000 bats were recorded during 2005 surveys in Coach Cave, KY. Three caves in Kentucky and Alabama could not be surveyed due to

hazards, and the survey team was not permitted by the land owner to survey Pearsons Cave in Tennessee. We will continue to seek access to Pearsons Cave in 2006.

The USFWS has finalized the list of Tennessee maternity cave sites to be surveyed in the summer of 2006. Heather Garland, Tennessee Chapter of The Nature Conservancy, has agreed to assume the responsibility of insuring that the surveys are conducted and will coordinate the work with the USFWS (Robert Currie, USFWS, Memo dated April 27, 2006). The caves to be surveyed are listed below (these sites represent a considerable increase over the number of sites requested for survey as part of the original Legacy project):

White Buis Cave	Claiborne Co.
Cripps Mill and Goat Caves	DeKalb Co.
Indiana Cave	Grainger Co.
Bellamy Cave	Montgomery Co.
Tobaccoport Cave	Stewart Co.
Oaks Cave	Union Co.
Pearson Cave	Hawkins Co.
Bat Cave	Hickman Co.
Dud's Cave	Jackson Co.
Bat Cave	Lincoln Co.
Alexander Cave	Perry Co.
Grassy Creek Cave	Rhea Co.
Harris Cave	Rhea Co.
Herron Cave	Rutherford Co.
Bridgewater Cave	Smith Co.
Piper Cave	Smith Co.
New Piper Cave	Smith Co.
Haile Cave	Jackson co.
Coleman Cave	Montgomery Co.
Morrell Cave	Sullivan Co.
Rose Cave	White Co.
Hound Dog Drop Cave	Wayne Co.
Knowles Ridge Cave	Warren Co.

The work towards completing protection of Bellamy Cave is proceeding on schedule. The temperature monitoring of roost sites in the cave has been initiated, and a new map of the cave is near completion. The map will be useful for analyzing how and where to construct the Bellamy Cave gate. As soon as the pre-construction temperature study is completed, the gate will be constructed at the main entrance to the cave (Robert Currie, USFWS, Memo dated April 27, 2006).

Plans have been made to make improvements to Jesse James Cave, KY. The project will be initiated over Memorial Day 2006 weekend and will require several weekends to complete. It is estimated that it will probably be Labor Day 2006 before the entire project is finished. All of the work will be done by members of the Coach and

James Caves Mapping Group; they will be working officially as USFWS volunteers while removing the stairs (Robert Currie, Memo dated May 4, 2006).

Approximately $40,000 is available from the Legacy project to secure the protection of Pearsons Cave, TN. A conservation easement held by the State of Tennessee is envisioned. The owner of the cave is not receptive to discussions on the cave and USFWS is continuing efforts to encourage the owner's cooperation.

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